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Regional Approach to Wildlife Monitoring Related to Energy Exploration and Development on the NPR-A

Final draft product

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Executive Summary

After a formal evaluation of wildlife monitoring assessment activities related to the oil and gas program, the U.S. Department of the Interior, Bureau of Land Management (BLM) National Monitoring Strategy, Wildlife Regional Energy Monitoring Strategy Subgroup (WREMSS) recommended that a regional monitoring process be developed and used for energy planning and development to accurately describe and track the changing conditions on the land. This report describes a recommended standardized process to be followed to adequately plan, collect, disseminate, and use data for regional wildlife management as it relates to energy exploration and development on the North Slope of Alaska, specifically, the National Petroleum Reserve, Alaska (NPR-A). The Standard Process incorporates the concept of adaptive resource management (ARM), and is guided by previously-developed concepts of effective monitoring presented by Mulder (1999).

The recommended Standard Process involves five steps that guide the monitoring team from a starting point of setting goals and assessing monitoring needs (Step A) to assessment of the program outcomes and modification of the program based on the lessons learned during the monitoring process (Step E). Included in the process is a goal setting strategy that allows for management of wildlife at broader scales than often carried out for satisfying local lease-level requirements. Among other recommendations is the development of a data management system to hold a comprehensive set of monitoring data that is secure and available for many years to come, and a process to use focus groups to help formulate goals and provide expertise on selection of issues and indicators for monitoring. Finally, the Standard Process includes provisions to use monitoring data outcomes to make sound management decisions and to drive revisions to management decisions, monitoring goals, and monitoring data collections that were found to be deficient (ARM).

The regional monitoring process described here was developed for the National Petroleum Reserve – Alaska (NPR-A), but has relevance to the entire North Slope and other areas of energy exploration and development in the United States. Extensive work by the Research and Monitoring Team (RMT), formed to develop a wildlife monitoring plan for the NPR-A, has provided a strong starting point for implementation of the Standard Process for NPR-A. In addition to the general Standard Process guidelines, an example of the Standard Process is presented in the companion document *Example of Standard Process: Monitoring Caribou in NPR-A*. The example provides a run-through of the Standard Process using RMT-based planning work and GIS-based data sets collected on caribou movement and infrastructure development. The example helps to illustrate the use of the data management system for decision support through a decision support system (DSS).

Specific recommendations regarding implementation of a Regional Monitoring program are also made in this report, including a phase-in procedure. The extensive goals-setting and conceptual-level work done by the RMT for NPR-A provides a solid beginning to allow *Phase I* of the implementation to be very effective. *Phase II* activities include a revision of the conceptual models developed by RMT for the issues identified as critical to North Slope oil and gas development, improvements in base data sets, and implementation of validation studies to assess indicator sensitivity and refine target levels and thresholds based on hypotheses developed in *Phase I*. In *Phase III*, the Standard Process is fully implemented

and in a form that has been modified via the iterative process that has occurred in the early phases. The result is a fully vetted process and process components.

The process described in this document is not meant to be static. The Standard Process is adaptive, in that it that builds on the lessons learned as monitoring progresses, and it provides for an evaluation of monitoring and resource management effectiveness as a regular component of the process. Through this process, monitoring the effects of oil and gas activities on wildlife resources in regional settings will be: cost effective; improve the collection, integrity, and management of data; target research as an aid in management decisions; and incorporate broad-scale assessments, wildlife trend data, and other information for effective decision-making. A monitoring program that is repeatable, adaptive to change, and considers the bigger picture will focus the process, make it more transparent, and be most effective for wildlife management.

Introduction

The U.S. Department of the Interior, Bureau of Land Management (BLM) National Monitoring Strategy, Wildlife Regional Energy Monitoring Strategy Subgroup (WREMSS), was formed to evaluate the current state of the Bureau's wildlife inventory, monitoring, and assessment activities related to the oil and gas program. They found that, while all planning documents had a monitoring component, they were found to be generally ill-defined within the various activities. WREMSS recommended that a regional monitoring process be further developed and used for energy planning and development to accurately describe and track the changing conditions on the land.

This document describes a recommended process to be followed to adequately plan, collect, disseminate, and use data for regional wildlife management as it relates to energy exploration and development on the North Slope of Alaska, specifically, the National Petroleum Reserve, Alaska (NPR-A). The Standard Process developed for this activity is based on previously-developed concepts of effective monitoring modified from Mulder (1999) and provided in the Statement of Work drafted for this activity (the seven steps and the objectives from the Statement of Work are included as Appendix A). The Standard Process incorporates the concept of adaptive resource management (ARM), which provides mechanisms for the management team to use monitoring outcomes to modify management and monitoring strategies and improve wildlife management and monitoring activities. The process described was developed using a number of resources from within and outside BLM, which are listed in the bibliography at the end of the document. Meetings and interviews conducted to help formulate the process are listed in Appendix B.

The document suggests the development of a data management system to hold a comprehensive set of monitoring data that is secure and available for many years to come, be it tabular-based information on wildlife populations, spatially- and temporally-defined infrastructure data in a GIS, or remote sensing-based image data. This consistent, long-term data will be of great value as it is built over many years.

The recommended Standard Process involves five steps that guide the management team from a starting point of assessing monitoring program needs to assessment of the program outcomes and modification of the program based on the lessons learned. The process includes the seven-steps for effective monitoring modified from Mulder (1999) and provided in the Statement of Work drafted for this activity (Appendix A). Included in the process is a goal setting strategy that allows for management of wildlife at broader scales than often carried out for satisfying local lease-level requirements. Specifically, the process will infuse a regional-scale (across planning areas) wildlife management approach not typically achieved through current management processes.

This document presents the Standard Process as well as recommendations for implementing the Standard Process in three phases. Other recommendations are also made to make the process feasible and effective. These guidelines and recommendations provide steps of a process to be used in monitoring program planning so that monitoring programs are repeatable, adaptive to change, and so they consider the bigger picture, thus providing an effective monitoring program to properly maintain and improve BLM lands.

Background

Findings of the Wildlife Regional Energy Monitoring Strategy Subgroup (WREMSS)

In their review of BLM programs, the WREMSS found that monitoring in the oil and gas program is generally focused on compliance and effectiveness monitoring at the local lease level. While this focus brings efficiency and stated direction to the oil and gas program, it does not provide for monitoring wildlife species and habitats beyond the local lease area. Because many species of wildlife have habitat requirements that expand well beyond those local areas where oil and gas activities are occurring, analysis of monitoring information should occur on a much larger scale. In many cases, regional monitoring activities will involve shared information and application over multiple land use planning areas, Field Offices, or State Offices. It is important to note that WREMSS also determined that regional information alone will not be sufficient to determine effectiveness of local mitigation measures, improved cumulative impact analysis, or tracking of landscape changes over time. However, a comprehensive regional approach that incorporates local monitoring information can be used collectively to understand the health and condition of wide-ranging habitats, including changes influenced by land uses.

The WREMSS evaluation found that the development of monitoring plans that follow a logical approach for monitoring to answer management questions appear to be lacking. Based on an evaluation of how Field Offices are currently collecting and analyzing information, there is an indication that information is incomplete, not archived and retrievable, and insufficient to determine future changes in management direction. Without the identification of thresholds or triggers that lead to unacceptable impacts, adaptive management may not be effective. Opportunities exist to increase our understanding of potential fragmentation of landscapes, improve the cumulative impacts analysis and enhance communication and coordination internally and externally.

In addition, the evaluation found that communication and coordination of monitoring programs internally are deficient. The management questions and need for monitoring information are ill-defined across various activities within the BLM. Renewable and non-renewable resource programs have very different concepts of monitoring based on program responsibilities and directives.

In April 2005, the WREMSS prepared a Monitoring Strategy Action Plan identifying four key management questions that should be answered with monitoring information. These questions were derived from feedback from active energy states and Field Offices.

1. What are the condition and trends of wildlife habitat in basins emphasized in the Energy Policy and Conservation Act (EPCA) report?
2. What are the stressors or drivers of change that affect wildlife habitat in basins emphasized in the EPCA report?
3. Are applied mitigation and best management practices for habitat and human disturbance related to energy development effective in the conservation of wildlife habitat?

4. Are reclamation activities related to energy development accomplishing wildlife and associated habitat objectives as stated in the activity plans and/or land use plans?

The WREMSS recommended that a regional monitoring process be developed and used for energy planning and development to accurately describe and track the changing conditions on the land. Three representative regions were chosen in energy exploration and development areas to develop the regional monitoring process, one of which is the NPR-A on the North Slope of Alaska. The regional monitoring process that is developed will facilitate managers in addressing the four questions laid out by the WREMSS. It will also provide for a comprehensive evaluation of existing baseline and monitoring information, describe how information is stored, retrieved and analyzed, and explain how the results can be utilized by managers to support decisions related to energy development. The process document will describe how the regional monitoring framework can be integrated into BLM's land use decision-making process, manuals or handbooks, and will provide guidance to help Field Offices develop monitoring initiatives that can be upscaled to both regional and national levels.

Activity of the Research and Monitoring Team (RMT) for the NPR-A

In October 1998, a Record of Decision (ROD) was published for the Northeast NPR-A Final Integrated Activity Plan/Environmental Impact Statement (IAP/EIS). The ROD established a Research and Monitoring Team (RMT) to advise the BLM on research and monitoring projects related to surface resource impacts and the effectiveness of stipulations. The RMT was comprised of representatives from federal agencies (MMS, DOE, USGS, USFWS, BLM), state agencies (ADF&G), local government (NSB), public at large (ASRC), industry (CPAI), academia (UAF) and environmental non-government organizations (Audubon Alaska). The RMT met 11 times starting in 2000 and recommended a prioritized list of research and monitoring topics to the BLM for funding. This group continued to function as a subset of the Resource Advisory Council (RAC) to the BLM, until the establishment of a similar Science Technical Group that supports the North Slope Science Initiative (NSSI).

In 2004 the RMT was tasked with developing a monitoring plan for the NPR-A with the potential to be extended to other North Slope lands. Before such a plan could be prepared, the RMT developed a framework to guide the preparation of a science-based plan (*Bureau of Land Management. 2004. The Strategy for a Monitoring Plan for the National Petroleum Reserve-Alaska. Bureau of Land Management, Resource Monitoring Team (RMT)*). The strategy document lists several criteria that RMT thought would be important in guiding the development of a monitoring program. These parallel the ideas of the WREMSS for the broader monitoring process. In particular, the strategy document for development of a monitoring plan for NPR-A states that:

> *"The intended outcome is the adaptive management of the NPR-A, meaning a decision-making process that can evolve to ensure the effectiveness of surface resource protection while allowing for the development of oil and gas. Monitoring is critical to the success of this effort. However, the current plans for the NPR-A stop short of stating measurable objectives which stem from the [stated] goals."*

The goals of the NPR-A monitoring plan as determined by the RMT, are:

1. Assess the effects of oil and gas related activities on various surface resources in the NPR-A, human uses of those resources, and sociocultural systems.
2. Determine the effectiveness of current mitigation measures and management policies, assist with answering current and future management questions, and improve the effectiveness of future decisions and mitigation measures (i.e. adaptive resource management).

The RMT developed a list of environmental and social issues that warranted further monitoring, on the basis of their importance to various regulatory agencies, local residents and other stakeholders. Some of these issues are currently important for data collection, while others may be less critical immediately but could be more so in the future as oil and gas development expands. Monitoring all components of an ecological or socio-cultural system is not practicable and likely cost-prohibitive, thus an attempt was made by RMT members to select issues on the basis of ecological and social criteria.

A set of ten issues were identified for monitoring in the NPR-A through the process followed by the RMT:

1. Caribou population and harvest
2. Molting geese
3. Fisheries
4. Change in subsistence access
5. Predator/prey relationships
6. Socio-cultural systems
7. Cliff-nesting raptors
8. Migrating bowhead whales
9. Endangered species populations (eiders)
10. Environmental contaminants

The RMT strategy document provides the background of the rationale for selection, a list of potential indicators to be monitored, and the conceptual models for each issue, which illustrate the interactions of potential driver and response variables as they relate to the issue of concern.

In 2006, subsequent to the RMT planning work, Bruce Hollen of BLM-Alaska set out to provide a framework for monitoring in the NPR-A that draws substantially from the RMT plan (Bureau of Land Management 2006). The monitoring framework he developed serves as a broader conceptual document, but provides details that were not included in the RMT plan. This includes a review of the regulatory drivers to monitoring goals as well as a presentation of needs for an information management system.

Development of a Standard Process for Regional Wildlife Monitoring

Based on the needs and direction defined by the WREMSS and using the RMT plan and B. Hollen Monitoring Framework documents as a starting point (Bureau of Land Management 2004, Bureau of Land Management 2006), a Standard Process has been developed that will help adequately plan, collect, disseminate, and use data for regional wildlife management as it relates to energy exploration and development on the North Slope of Alaska, specifically, the National Petroleum Reserve, Alaska (NPR-A). The intent is to provide guidelines for a

process to monitor wildlife habitat and populations at regional scales to be used to accurately describe and track changing conditions on the land. While the focus of this set of process guidelines is on management related to energy exploration and development, the approach can be applied more broadly and could potentially be implemented as a consistent approach to monitoring wildlife habitat and populations across BLM-managed lands where land use issues need to be considered. Overall, the regional approach would be used in addressing cumulative impacts and species conservation planning over scales larger than typically monitored for local lease compliance. The process would be used to support decision-making for regional land use planning and compliance with the National Environmental Policy Act (NEPA).

The initial step in regional wildlife monitoring is to set goals for consistent and effective monitoring over multiple lease sites and over extended time frames that are consistent with wildlife management goals and activities (Figure 1). These monitoring goals are driven by several factors including regulatory requirements. The National Petroleum Reserve Production Act (NPRPA), Federal Land Policy and Management Act, and the NE NPR-A 1998 Record of Decision (ROD) all directly or indirectly require monitoring to ensure the goals of those acts are met. The NW NPR-A Environmental Impact Statement (EIS) and the NE NPR-A EIS Amendment introduced performance based Required Operating Procedures (ROPs) and lease stipulations as mechanisms to meet the requirements for "surface protection" and prevention of "undue or unnecessary degradation" within NPR-A (Appendix C). Thus one of the overriding goals of monitoring is to determine the efficacy of the ROPs and lease stipulations by describing response of focal resources to development. This includes cumulative impacts and impacts at scales beyond the local lease.

The goals of a regional monitoring program are often defined by ecological circumstances and management needs not explicitly laid out as regulatory requirements. In the Monitoring Strategy Action Plan written up by the WREMSS, four key management questions were identifying from feedback from active energy states and Field Offices (see above). These management questions are useful in development of regional monitoring goals, and they should be considered as important as the regulation-derived goals in development of monitoring program goals. The monitoring requirements defined across adjacent land management units, whether regulation-driven or based on larger wildlife management goals, become the basis for developing monitoring goals and plans, one of the initial activities prescribed in the Standard Process (Step A).

In the following sections of this report, the Standard Process for development and implementation of a regional monitoring program is presented step-by-step. Management goals, as defined through the mechanisms described above, feed directly into Step A of the Standard Process to guide the goals of the monitoring program. The work of the RMT and B. Hollen (Bureau of Land Management 2004, Bureau of Land Management 2006) provide the broad monitoring goals that start the process (see above). The RMT-defined issues and indicators provide the impetus for monitoring and data collection needs. As the process is implemented, the monitoring goals are tested and modified as information gaps are filled through monitoring results.

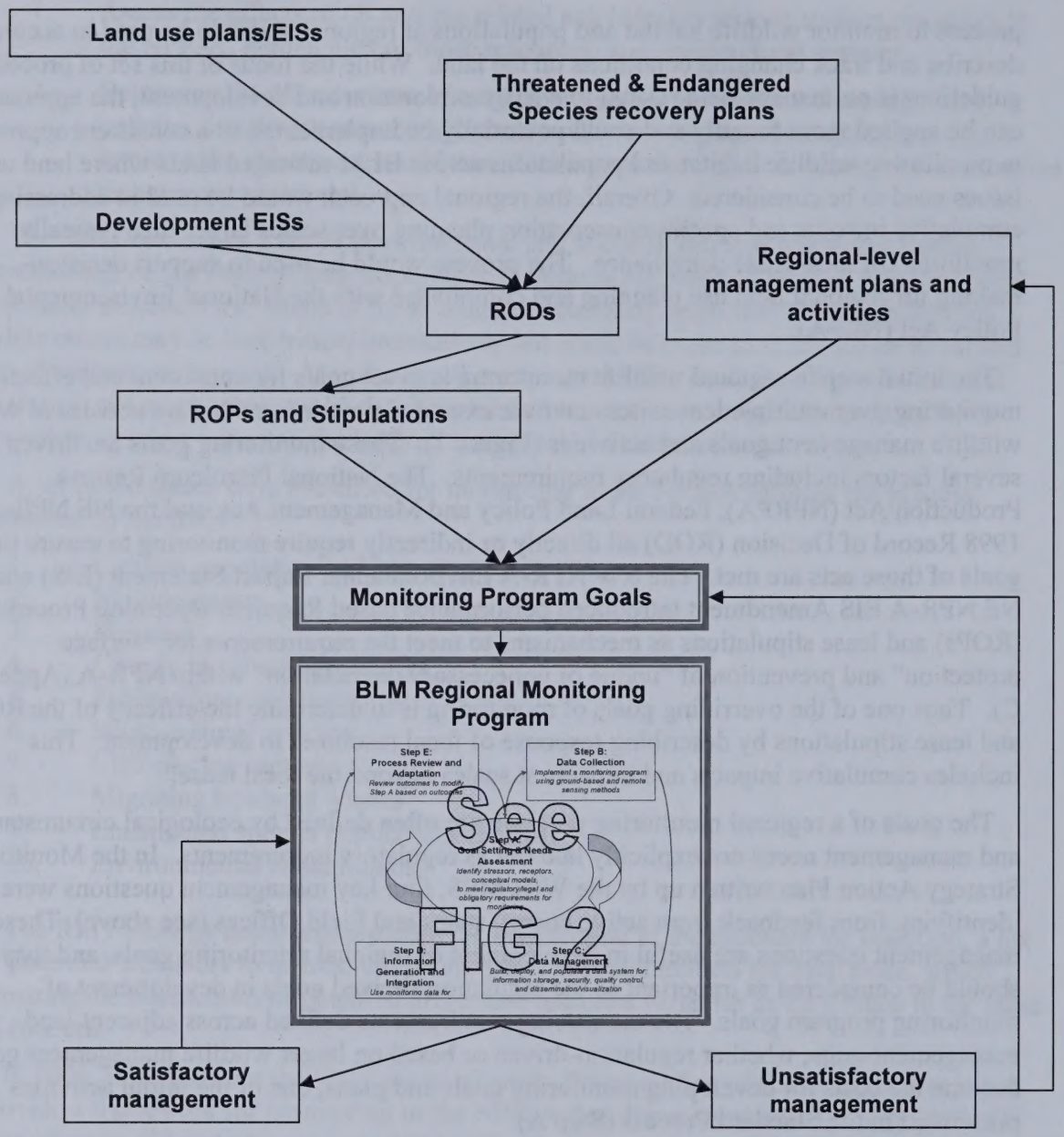

Land use plans/EISs
Threatened & Endangered Species recovery plans
Development EISs
RODs
Regional-level management plans and activities
ROPs and Stipulations
Monitoring Program Goals
BLM Regional Monitoring Program
Step E: Process Review and Adaptation
Review outcomes to modify Step A based on outcomes
Step B: Data Collection
Implement a monitoring program using ground-based and remote sensing methods
See
Step A: Goal Setting & Needs Assessment
identify stressors, receptors, conceptual models, to meet regulatory/legal and obligatory requirements for monitoring
FIG 2
Step D: Information Generation and Integration
Use monitoring data for
Step C: Data Management
Build, deploy, and populate a data system for: information storage, security, quality control, and dissemination/visualization
Satisfactory management
Unsatisfactory management

Figure 1. Overall land management process showing the role of a regional monitoring program.

The first of the issues identified by RMT, caribou population, has been selected to be used in this project as an example of the Standard Process. Data collected on Caribou distribution and movements in relation to oil field infrastructure is being used for this example. A write-up of this example is included with this report as a companion document entitled *"Example of Standard Process: Monitoring Caribou in NPR-A"*.

Standard Process Components

The regional monitoring process described here was developed for the NPR-A, but is relevant to the entire North Slope and other areas of energy exploration and development in the United States. The suggested process involves five steps that guide the management team from a starting point of setting goals and assessing monitoring needs (Step A) to assessment of the program outcomes and modification of the program based on the lessons learned during the monitoring process (Step E). Step C involves the use of a data management system that will need to be developed early in the process so that monitoring data produced in Step B can be put into the system in a timely fashion. This document describes both development of the data management system (Appendix E) and a suggested process for use of that system. Figure 2 provides an overview of the five steps.

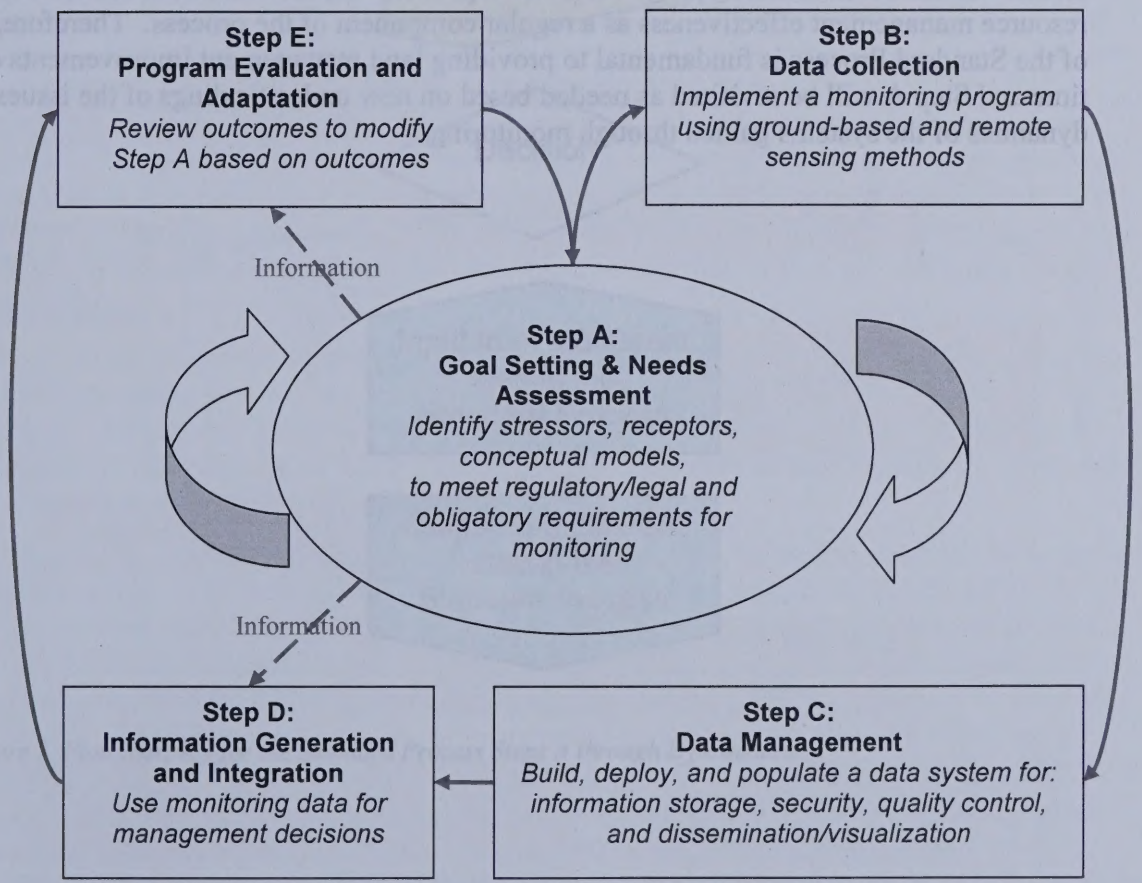

Step E:
Program Evaluation and Adaptation
Review outcomes to modify Step A based on outcomes
Step B:
Data Collection
Implement a monitoring program using ground-based and remote sensing methods
Information
Step A:
Goal Setting & Needs Assessment
Identify stressors, receptors, conceptual models, to meet regulatory/legal and obligatory requirements for monitoring
Information
Step D:
Information Generation and Integration
Use monitoring data for management decisions
Step C:
Data Management
Build, deploy, and populate a data system for: information storage, security, quality control, and dissemination/visualization

Figure 2. Flowchart of the regional monitoring process steps developed for the NPR-A Regional Monitoring Program.

The following sections detail the process diagramed in Figure 2. In each section a flowchart is shown to visualize the overall step process and a detailed description is made for each sub-step. A key to flowchart shapes is given in Figure 3. In each step, a statement is made about how each part of the Standard Process compares with the seven-steps for effective monitoring modified from Mulder (1999) and provided in the Statement of Work drafted for this activity (Appendix A). Steps 1-5 are encompassed in Step A of this Standard Process. For the NPR-A, the initial steps described in Step A were performed by the RMT, including setting monitoring program goals and identifying issues (Step 1), characterizing stressors and receptors (Step 2), development of conceptual models of the identified issues (Step 3), listing indicators to be measured (Step 4), and testing their sensitivity for detecting change (Step 5). Steps 6 and 7 of the process framework are accomplished via an iterative process between Steps D, E, and A of the Standard Process using data collected and made available in Steps B and C.

It should be noted that each step flows from the previous, and feeds the next. This flow should be generally seamless, so the divisions between steps are not discrete, and the conceptual framework fluid. The outlined process is adaptive, in that it that builds on the lessons learned as monitoring progresses, and it provides for an evaluation of monitoring and resource management effectiveness as a regular component of the process. Therefore, Step E of the Standard Process is fundamental to providing land management improvements over time and Step A will be revisited as needed based on new understandings of the issues and dynamics of the systems gained through monitoring.

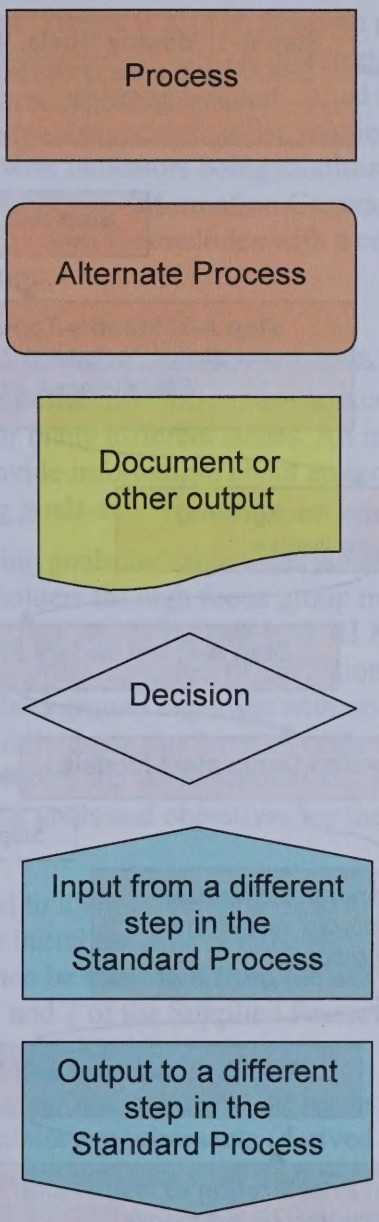

Process
Alternate Process
Document or other output
Decision
Input from a different step in the Standard Process
Output to a different step in the Standard Process

Figure 3. Flowchart key for the Standard Process Steps A through E flowcharts.

A. Goal Setting and Needs Assessment

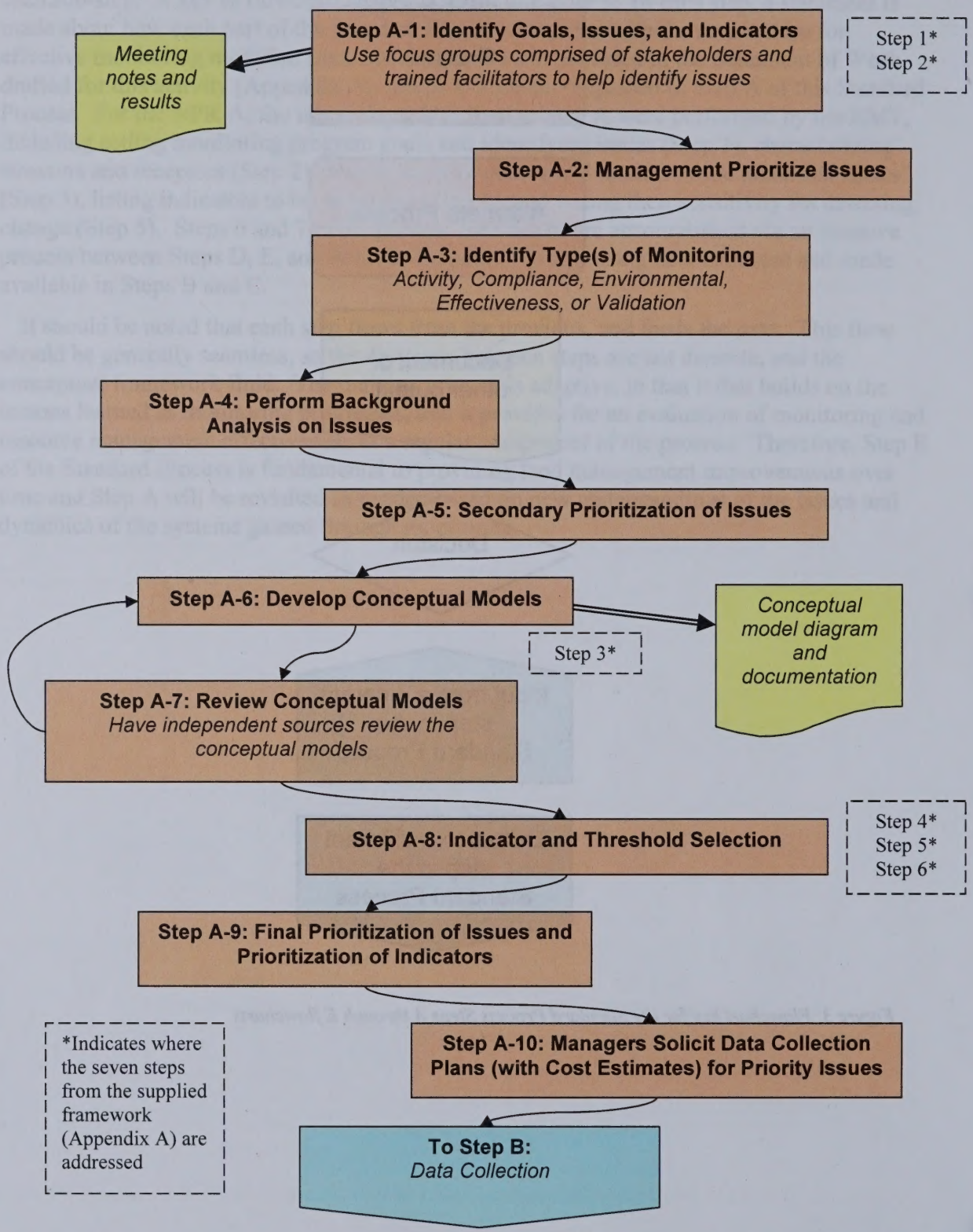

Step A-1: Identify Goals, Issues, and Indicators
Use focus groups comprised of stakeholders and trained facilitators to help identify issues
Meeting notes and results
Step 1*
Step 2*
Step A-2: Management Prioritize Issues
Step A-3: Identify Type(s) of Monitoring
Activity, Compliance, Environmental, Effectiveness, or Validation
Step A-4: Perform Background Analysis on Issues
Step A-5: Secondary Prioritization of Issues
Step A-6: Develop Conceptual Models
Step 3*
Conceptual model diagram and documentation
Step A-7: Review Conceptual Models
Have independent sources review the conceptual models
Step A-8: Indicator and Threshold Selection
Step 4*
Step 5*
Step 6*
Step A-9: Final Prioritization of Issues and Prioritization of Indicators
Step A-10: Managers Solicit Data Collection Plans (with Cost Estimates) for Priority Issues
To Step B:
Data Collection
*Indicates where the seven steps from the supplied framework (Appendix A) are addressed

Figure 4. Flowchart showing the structure of Step A of the Standard Process: Goal Setting & Needs Assessment

Overview of Step A

Step A is the first step of the Standard Process, but since a key component of the Standard Process is adaptive management, Step A is also an iteration point that can be revisited several times. Step A includes the identification of NPR-A monitoring goals, issues, and indicators. An integral part of Step A is the development of conceptual models of the identified issues that help organize the issue components and establish relationships between drivers and responses and the relationship with indicators being monitored. The conceptual models developed in Step A are used in Step D: Information Generation and Integration to develop decision support systems (DSS). Step A concludes with a continuation to Step B of the Standard Process: Data Collection.

Step A-1: Identify Monitoring Goals and Objectives, Issues, and Indicators

A comprehensive, regional wildlife monitoring program consists of individual and inter-related monitoring programs for many different issues. An indicator is something that is measured and monitored to provide information about an issue. Issue and indicator selection must be based upon monitoring goals and objectives.

Identification of the monitoring goals and objectives is best achieved through input from North Slope experts and stakeholders through focus group meetings (*see below a section on how to conduct focus groups*). This would include both BLM resource specialists and managers and professional from other agencies, organization, and institutions from the region(s) of interest who have background expertise with on-going monitoring programs. It would also be helpful to have individuals that have an understanding of the requirements set forth by the regulatory RODs, ROPs and lease stipulations. In this step, focus groups will be used to first identify overarching goals and objectives for the NPR-A and the entire North Slope region.

Focus group will also be used to identify issues critical to oil and gas development on the North Slope and to generate an initial list drivers (stressors) and responses (receptors) for each issue. Indicators should then be identified from the drivers/responses list. The focus group activity includes Steps 1 and 2 of the Supplied Framework and Anticipated Approach from the Statement of Work (Appendix A).

Development of monitoring goals and management issues defined through the focus group activities is driven by both regulatory requirements (derived directly from EIS, ROD, ROP's and lease stipulations) and by ecological and wildlife management considerations defined through regional management plans and activities (see Figure 1). The regulation-driven monitoring needs defined for adjacent land management units should be considered in order to identify overlapping needs and monitoring activities that can be done at broader scales than may be dictated by one ROD or EIS alone. A review of the Northeast NPR-A ROD and the Northwest NPR-A EIS-based ROPs and lease stipulations (Appendix C) shows a great deal of overlap in requirements and some inconsistencies that need to be considered in concert. One of the first activities to be considered by the focus groups is to review these regulatory-driven monitoring needs for the region (across the management units within NPR-A, in this case) to design monitoring goals that address cross-unit needs.

Goals should be formulated that consider regulatory, ecological, and wildlife management needs. The goals defined by the focus group process should be measurable with explicit

target levels and/or thresholds defined for defining management response. They should allow for a full understanding of long-term and cumulative impacts of oil and gas development for the issues identified.

In respect to wildlife monitoring related to energy exploration in NPR-A, several goals have already been identified by the NPR-A RODs and the RMT. The Northeast and Northwest ROD share two broadly stated (or implied) goals: protect surface resources and their traditional uses; and allow for oil and gas lease sales, and subsequent development. The RMT identified two goals: assess the effects of oil and gas related activities on various surface resources in the NPR-A, human use of those resources, and sociocultural systems; and determine the effectiveness of current mitigation measures and management policies, assist with answering current and future management questions, and improve the effectiveness of future decisions and mitigation measures (i.e. adaptive management). These previously identified goals should be kept in mind and reintroduced during the focus group process.

Goals, issue, and indicator selection must be guided by social and ecological responses. Issues that have local, regional, or national values, or issues given special status through law and policy (e.g., endangered species under the Endangered Species Act of 1973) are examples of issues resulting from social responses. Issues that are particularly susceptible to oil and gas development activities or issues that display a response that is large in scale or that occurs in an area with unique qualities are examples of issues resulting from ecological responses. To help guide focus group participants, the following criteria developed by the RMT may serve to spark discussions:

A. Ecological
    1. There is a strong likelihood of response to specific stressors associated with oil and gas activities (need an explicit model linking stressor to indicator).
    2. Scale of response is significant at the population, ecosystem, or landscape level.
    3. The response occurs in a local or regional area that has unique qualities.
B. Social
    1. Indicator is of high value to the local community.
    2. Indicator is of high value to a broader public interest.
    3. Indicator has special status established by law or policy.

The term issue does not exclusively entail a problem or a concern. An issue could also be a specific specie, or group of species, of interest. Depending on the identified goals, the first round of issue identification might be a list of species of concern and the second round might entail a list of specie-specific issues.

Guidelines for conducting Focus Group Meetings: Goal, Issue, and Indicator Identification

Identification of goals, issues, and indicators need to occur with the guidance of stakeholders and North Slope experts. An effective way to solicit their input is through the use of focus groups that bring together individuals with different expertise and backgrounds to share ideas and move towards a common goal. Focus group meetings follow a logical progression of activities with the goal of creating defined outputs. In this case, the desired

meeting output is identification of: NPR-A and regional monitoring goals; issues; issue components (drivers/responses); and indicators.

Focus group meetings can last one or several days and groups can meet once or multiple times. As a general rule, the success of a focus group meeting is dependent on the working relationships among participants, which is usually cultivated over time through many meetings. Since the group of North Slope managers and scientists is small, several meetings may not be required. A two day meeting may be sufficient to assemble the desired output.

Several key positions are integral to the focus group process. These positions include: facilitator, recorder, chair, and co-chair. One participant (most likely a BLM employee) would serve as the chair, and another participant would be selected as a co-chair. The chair and co-chair provide peer leadership and domain expertise for the group. The recorder has the specific task of recording the output of the group. The facilitator leads the groups through the agenda, solicits inputs, keeps the discussion on track, and guides the process in general. Together, the four group leaders are also responsible for summarizing and reporting the outcomes to the rest of the group.

Engaged and dedicated participants are highly important to the success of the focus group process. As part of this recruitment process, expectations for participants must be explained in advance and participants should be provided with adequate background information to allow them to participate fruitfully in the discussions. To convey this information, a standard briefing booklet should be provided that contains both administrative information and technical information related to the effects of oil and gas development on the North Slope.

One thing to keep in mind is that focus group participants should not feel as if they are being used for their knowledge and expertise. Participants should feel as if they are receiving something for their participation. This could take the form of a keynote address by a prominent person in the North Slope community, or could be a workshop on a new technology. Food and beverages can also be a powerful motivational tool.

In developing focus group meetings it is important not to overlook administrative details. Administrative support needs might include: preparing agendas, preparing and distributing meeting materials, coordinating and providing necessary audiovisual equipment; taking meeting minutes; coordinating meeting schedules; processing travel reimbursement; etc. These details can make or break a focus group meeting.

At the completion of each focus group meeting, meeting notes and results should be complied into a report. This provides the documentation for later review and analysis. Documentation is also important to reduce future duplication of effort.

Step A-2: Management Prioritize Issues

At the conclusion of the focus group meetings, the results need to be complied, and the managers should meet and discuss the meeting outputs. In this step management will specifically prioritize the identified issues. Prioritized ranking are necessary due to resources limitations (time, money, staff, etc.) which make it impossible to fund and execute projects for all of the identified issues. This initial prioritization focuses subsequent work on those issues of most importance and thus provides the most effective use of available resources.

Prioritization should be primarily based upon BLM mandates and policies and the monitoring goals and objectives identified through the focus group process and laid out in the regulatory requirements. Other ancillary factors can also be incorporated into the prioritization scheme, such as a high priority assigned to issues that have a high degree of interrelatedness with other issues (i.e. indicator overlap). Management is responsible for collectively determining the prioritization criteria used in this step.

Step A-3: Identify Type(s) of Monitoring

In this step, the type of monitoring required for each issue is identified. A comprehensive monitoring plan for the NPR-A should include all of the monitoring types, but for each individual issue one, several, or all of the monitoring types may be applicable. Once monitoring types are identified, it is important to keep this in mind as progression through the Standard Process occurs, because the monitoring type(s) drives later steps in the Process such as the development of conceptual models, field activity plans, and the type of management activity or decision to be made.

There are different types of monitoring, and definitions of monitoring types can vary between different groups and agencies. As applicable to BLM's mission in the NPR-A, the RMT identified five different types of monitoring. The five types are:

- Compliance
- Activity
- Environmental
- Effectiveness
- Validation

Compliance monitoring involves implementing terms and conditions of BLM policy. This may include documentation of required mitigation measures or ensuring that infrastructure is built in accordance with BLM policy.

Activity monitoring is similar to compliance monitoring because both types measure human effects, but activity monitoring is concerned with measuring human effects outside the realm of law or policy. Activity monitoring involves the collection of data that relates to how human have changed the environment. For example, an inventory of infrastructure or data collected to determine ice road impacts are examples of activity monitoring.

Different from both compliance and activity monitoring, environmental monitoring is concerned solely with natural events. Data collected from meteorological or hydrological gauge satiations are examples of environmental monitoring. This type of monitoring is sometimes called baseline monitoring.

Effectiveness monitoring entails documenting the status and changes occurring to ecological resources and sociocultural conditions. Unlike the first three types of monitoring (compliance, activity, and environmental), effectiveness monitoring requires the implementation of a scientific methodology. An example is a breeding bird survey or population counts of a specific species.

Validation monitoring is concerned with cause and effect relationships that exist between management policies and the indicator or resource being managed. Similar to effectiveness

monitoring, validation monitoring also requires the use of the scientific method. Peer-reviewed studies are example of validation monitoring.

These five categories are comprehensive, and provide an excellent starting point for identifying goals and objectives for different monitoring programs. Recall, that the five types are not mutually exclusive, and a monitoring program can be developed under one, several, or all of the types.

Step A-4: Perform Background Analysis on Issues

Once issues have been selected and the monitoring type(s) identified, it is important to perform a cursory background analysis on the identified issues. This information will be used to help further prioritize the issues and develop the conceptual models. The lists of stressors/responses and indicators derived from the focus group meetings should be used to bound the analysis.

The following background information should be collected for each issue:

- Previous and current research activities or monitoring programs, including any associated data sets, documentation, or reports;
- General idea of costs associated with measuring identified indicators;
- Natural variability of indicators;
- Spatial and temporal scale of indicators;
- Known thresholds for identified indicators;
- Degree of issue and indicator response to oil and gas development activities;
- Any applicable laws and policies;
- Value to North Slope communities and the broader public interest;
- Synergy with other issues (i.e. can indicator support data requirements for other issues?); and
- Any additional information that will help guide indicator selection, development of the conceptual models, prioritization of the issues, or overall monitoring implementation.

Step A-5: Secondary Prioritization of Issues

In this step, the initial priority determined in Step A-2 should be revisited and modified if necessary. In addition to the criteria used to determine initial priority, the type of monitoring identified (Step A-3) and the information obtained from the background analysis (Step A-4) should also be considered. Depending on the number and complexity of issues identified, some issues may need to be completely removed in order to keep the list manageable. This determination should reside with the management team. Resource specialists should also be involved in this step if more issue information is needed.

Step A-6: Develop Conceptual Models

Conceptual models use a set of model components and a set of relationships between components to represent issues in a logical framework. Conceptual models will be developed in this step to represent the priority issues identified in previous steps. Several conceptual models have already been developed by the RMT for NPR-A and North Slope issues, and the

RMT report should be investigated before development occurs to avoid duplication of effort and to gain insight into product development.

In the conceptual models, model components should be classified as either driver (stressor), response (receptor), or both driver and response. Other model components may exist. Model components should be connected showing the direction of influence and the strength of the relationship. It is desirable to assign specific relationships between components in order to quantitatively understand driver/response relationships and strength of the relationship.

An initial set of drivers/responses were identified for each issue through the focus group process. The initial lists should be reviewed and refined in this step to create the final set of model components for each issue. A second round of focus group meetings could be used to formulate and define complex conceptual models. A one or two day meeting could easily be devoted the dissection and analysis of one issue (*see Step A-1 on how to conduct focus groups*).

A model diagram and any associated documentation is an end product of this step. This output is not static and should be updated as a result of the conceptual model review occurring in the next step. The model should also be modified as new information becomes available.

Step A-7: Review Conceptual Models

The conceptual model is integral for later steps in the Standard Process (Step D: Information Generation and Integration). In these later steps, a Decision Support System (DSS) will be created using the conceptual model, so it is imperative to carefully consider each model component and linkage. The conceptual models should be rigorously reviewed by independent sources to ensure complete representation of the issue. This review satisfies Step 3 of the Supplied Framework and Anticipated Approach from the Statement of Work (Appendix A).

An independent review is necessary because the conceptual models are simplifications of complex ecological, social, and cultural processes. Each issue is ingrained within several disciplines and areas of expertise. It is highly unlikely that one person or a small development team will have all the necessary expertise to assemble the full range of indicators and relationships between indicators.

Step A-8: Indicator and Threshold Selection

Using the list of indicators complied at the focus group meetings, the background information collected in Step A-4, and the conceptual models developed in Step A-6, managers and scientists need to determine which indicators provide the information required to address the priority issues. Indicators are what is measured in a monitoring program. One or several indicators may be applicable to a given issue, and indicators may overlap between issues. Typically, indicators are the actual components in the conceptual models (driver/response), but they may also develop from a model component when determining how to measure/monitor the component.

Certain indicators may be more or less sensitive to energy exploration and development activities on the North Slope. In this step it is necessary to conduct a power analysis of the

identified indicators to quantify this sensitivity. A power analysis provides the information required to determine indicator priority. This part of the process satisfies Steps 4 and 5 of the Supplied Framework and Anticipated Approach from the Statement of Work (Appendix A).

The second part of this step involves selecting thresholds for the issue of concern. A threshold is a level that when reached, triggers a management response. Threshold selection can be difficult due to data gaps and incomplete information concerning an issue and component relationships, but despite these obstacles, it is necessary to attempt to establish thresholds in this step because these values are needed in later steps of the Standard Process. This part of the process partially satisfies Step 6 of the Supplied Framework and Anticipated Approach from the Statement of Work (Appendix A).

Some issues will have well established thresholds, while other issues may not have enough background information to differentiate normal and unexpected conditions. Thresholds may also change over time as knowledge about an issue increase. In the meantime, managers and resource specialists should base threshold determination on the best available information. Threshold determination could also be a monitoring activity to be performed as part of the Standard Process.

At the conclusion of this step it may be necessary to revisit the conceptual model to integrate any new information.

Step A-9: Final Prioritization of Issues and Prioritization of Indicators

Using the information obtained in the previous steps and the prioritization criteria used in Steps A-2 and A-5, the issue priority list from Step A-5 should be revisited and modified if necessary.

In addition to the issue priority ranking, the indicators should also be prioritized. Selection of indicators priority should consider methodological, ecological, and social factors. Data collection methods need to be considered in the context of developing (new) technologies. For example, remote sensing allows for a cost-effective way of monitoring large areas, and new sensors and techniques are constantly under development. The following criteria, developed by RMT for selecting priority issues, should be used to help guide this process.

Methodological

- Indicator is measurable at reasonable cost
- Indicator can be measured accurately and precisely
- Indicators will be measured over long enough term to account for natural variability

Ecological

- Indicator exhibits a response to specific stressor associated with oil and gas activity
- Scale of indicator response is significant at population, ecosystem, or landscape level
- Indicator involves a unique local or regional area

Social

- Indicator is of high value to local community
- Indicator is of high value to a broader public interest
- Indicator has a special status established by law or policy

In this step both managers and resource specialists should be involved with priority determinations. The end product of this step is a manageable list of issues and indicators. It is important to keep in mind that only the highest priority issues will be investigated using only the highest priority indicators. For this reason, it is imperative that inputs from both managers and resource specialists are integrated into the prioritized ranking. This will insure that both regulatory mandates and ecological considerations are addressed in the monitoring efforts.

Step A-10: Managers Solicit Data Collection Plans (with Cost Estimates) for Priority Issues

This is the last step in the needs assessment portion of the Standard Process. In this step the managers releases the prioritized issue list and the conceptual models to all staff involved with data collection plans, in addition to the staff involved with monitoring plan development. Using this list, data collection plans with cost estimates will be developed for the priority indicators. This step is similar to a request for proposals announcement but with more transparency in what is desired in the proposal and what individuals might be vying for participation.

B. Data Collection

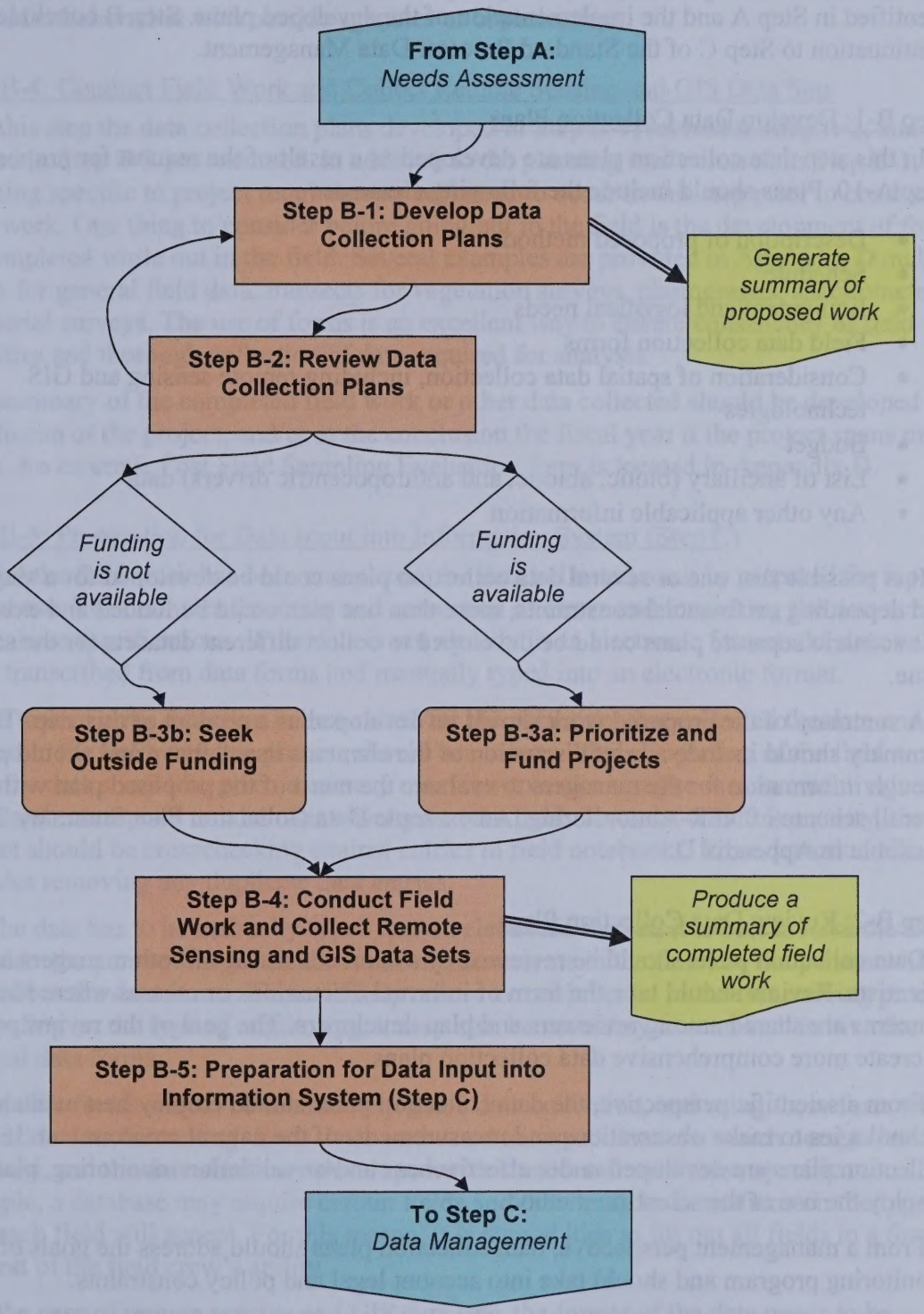

From Step A:
Needs Assessment
Step B-1: Develop Data Collection Plans
Generate summary of proposed work
Step B-2: Review Data Collection Plans
Funding is not available
Funding is available
Step B-3b: Seek Outside Funding
Step B-3a: Prioritize and Fund Projects
Step B-4: Conduct Field Work and Collect Remote Sensing and GIS Data Sets
Produce a summary of completed field work
Step B-5: Preparation for Data Input into Information System (Step C)
To Step C:
Data Management

Figure 5. Flowchart showing the structure of Step B of the Standard Process: Data Collection.

Overview of Step B

Step B includes the development of specific data collection plans for priority issues identified in Step A and the implementation of the developed plans. Step B concludes with a continuation to Step C of the Standard Process: Data Management.

Step B-1: Develop Data Collection Plans

In this step data collection plans are developed as a result of the request for proposals from Step A-10. Plans should include the following elements:

- Description of proposed methods
- Schedule
- Equipment and logistical needs
- Field data collection forms
- Consideration of spatial data collection, including remote sensing and GIS technologies
- Budget
- List of ancillary (biotic, abiotic, and anthropocentric drivers) data
- Any other applicable information

It is possible that one or several data collection plans could be developed for a single issue, and depending on financial constraints, more than one plan could be funded and executed. In this scenario separate plans could be developed to collect different datasets for the same issue.

A summary of the proposed work should be developed as a product of this step. The summary should include a brief discussion of the elements listed above and should provide enough information for the managers to evaluate the merit of the proposed plan within the overall scheme of NPR-A monitoring. An example Data Collection Plan Summary Sheet is available in Appendix D.

Step B-2: Review Data Collection Plans

Data collection plans should be reviewed by a team consisting of both managers and scientists. Review should take the form of informal discussions or memos where ideas and concerns are shared among reviewers and plan developers. The goal of the review process is to create more comprehensive data collection plans.

From a scientific perspective, the data collection plans should employ best available technologies to make observations and measurements of the natural environment. If data collection plans are developed under effectiveness and/or validation monitoring, plans should employ the use of the scientific method.

From a management perspective, data collection plans should address the goals of the monitoring program and should take into account legal and policy constraints.

Step B-3a: Prioritize and Fund Projects

If BLM funding is available, the management team needs to determine which data collection plans to fund.

Step B-3b: Seek Outside Funding

If BLM funding is not available, another option is outside funding. This could take the form of collaboration with outside agencies or organizations.

Step B-4: Conduct Field Work and Collect Remote Sensing and GIS Data Sets

In this step the data collection plans developed in Step B-1, revised in Step B-2, and funded in Step B-3 are executed. In addition to the planning that occurred in Step B-1, further planning specific to project requirements will need to occur in this step prior to conducting field work. One thing to consider before going out in the field is the development of forms to be completed while out in the field. Several examples are provided in Appendix D including forms for general field data, transects for vegetation surveys, photographs, spectrometer data, and aerial surveys. The use of forms is an excellent way to ensure consistency of field activities and thorough collection of data required for analysis.

A summary of the completed field work or other data collected should be developed at the conclusion of the project, and/or at the conclusion the fiscal year if the project spans multiple years. An example Post Field Sampling Evaluation form is located in Appendix D.

Step B-5: Preparation for Data Input into Information System (Step C)

After the field work has been completed, the data collected must be prepared for input into a database. This includes detection and correction of errors and formatting the data according to database specifications. If the data is not already in an electronic format, the data will have to be transcribed from data forms and manually typed into an electronic format.

The task of error detection is best suited for the personnel that collected the data and were present in the field, and this process should occur soon after completion of the field work. To start, the data should be given a cursory overview to make sure the measurement values make sense and correspond to what was observed in the field. To assist with this activity, the dataset should be crosschecking against entries in field notebooks. Error detection also includes removing any duplicate data entries.

If the data has to be manually typed into an electronic format, it is best to have the field recorder (the person who wrote down the measurements in the field) be the person who transcribes the data forms. This will help reduce errors inherent in the transcribing process. Depending on the type of monitoring, it may also be necessary to scan and archive the original data forms.

Specific forms should be used to help guide data collection, and using these form will help streamline data formatting. Each database has certain specifications which need to be followed, and the data sheets are developed with consideration of these specifications. For example, a database may require certain fields and there may be limitations on the type of data each field will accept. For this reason, it is a good idea to fill out all fields in a form to the best of the field crew's ability.

In the case of remote sensing and GIS data sets, the format of the data needs to be standardized in order to comply with data standards set up for the data management system. The origin of the data will dictate the level of effort for this step. Data standards for electronic products are explained in Step C and Appendix E.

C. Data Management

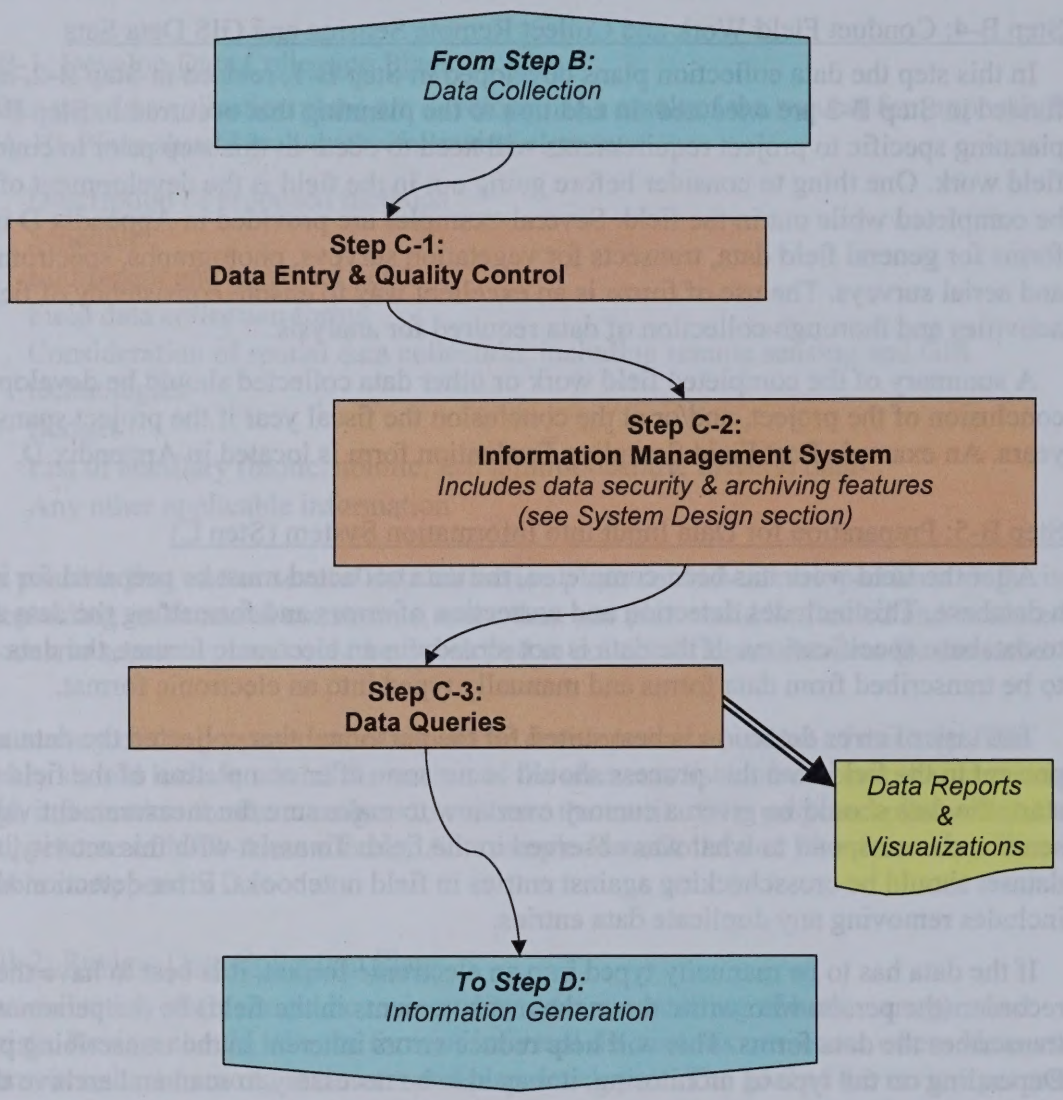


Figure 6. Flowchart for use of a database system.

Overview of Step C

Data management requires two vital components, a well designed information management system and use of the information system by populating it with monitoring data and using the information system through data queries. A suggested data management system with a description of features is given in Appendix E. Here we review the use of a data management system within the Standard Process.

The Standard Process being recommended for monitoring will require that data collected in the field or through remote sensing or GIS analyses be stored and accessible through the

database system built as described above. The payoff will be a system that holds a comprehensive data set that is secure and available for many years to come. This consistent, long-term data will be of great value as it is built over many years.

Step C-1: Data Entry and Quality Control

Data collected in Step B should be in a form that is easily put into the database through the data entry system set up when the information system was built. If the data is not properly formatted or has problems with critical data fields, this should be taken care of at this step. Metadata fields should be checked so that full compliance with metadata standards, such as ISO 19115, are met. Data quality comments should be included in the data set, such as any known problems with the data or metadata, its collection, or its reliability. Quality control, including any information on data problems, is important for being able to defend the data management system in the case of litigation or compliance requirements.

Step C-2: Information Management System

The design of a suggested information management system is described in detail in Appendix E. The system should be designed to be simple yet robust for the information types needed for effective monitoring. These include tabular data, images, and spatially-tagged information that can be stored and used in a GIS. The system should include industry standard features, so it is understandable to database experts not affiliated with the system designers, and should provide a data security features to make sure the information is secure yet accessible to the user who need access.

Step C-3: Data Queries

The final step in the data management process is for managers to access the information in the data system for use in Step D: Information Generation and Integration. The user will be able to create specific queries of the database to answer specific questions they expect the data collection activity to have revealed. Information would be available in tabular and/or map formats as described in the System Design section of this document.

D. Information Generation and Integration

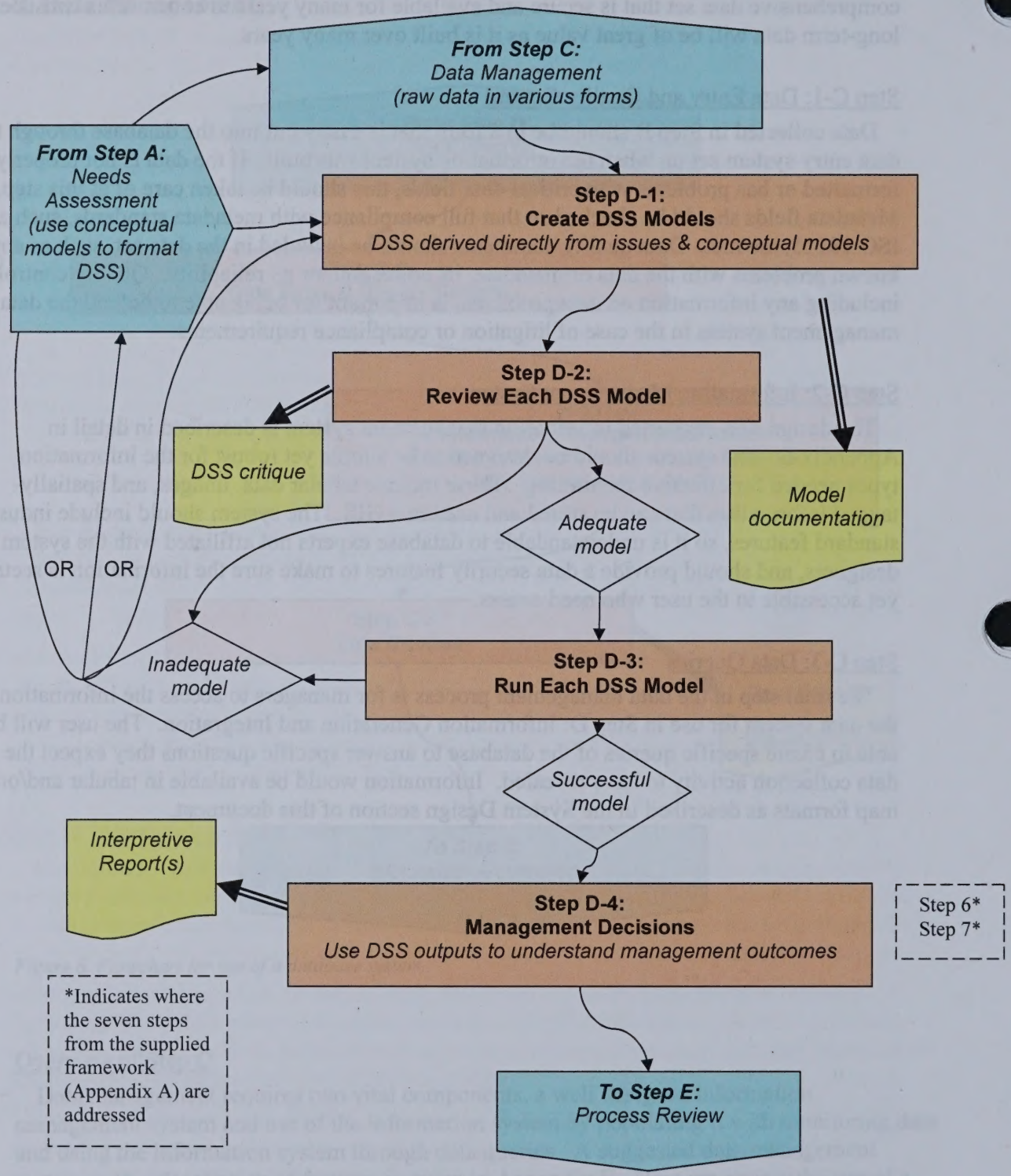


Figure 7. Flowchart showing the steps within Step D of the Standard Process: Information Generation and Integration.

Overview of Step D

Step D requires inputs from all previous steps, including the conceptual model(s) and threshold information provided in Step A and the monitoring data collected in Step B and archived and available through the data management system in Step C. The major component of Step D is the creation and execution of a Decision Support System (DSS). Figure 7 depicts a flowchart showing the major characteristics of Step D. The outcome from Step D is either a return to a previous step or continuation to Step E: Process Evaluation and Adaptation.

Decision support models are developed to help managers use data to make decisions regarding the issue(s) at hand. A DSS is an interactive, flexible, and adaptable computer-based information system. It utilizes data, provides an easy-to-use interface, and allows for the decision maker's own insights to improve decision making (Turban 1995).

The monitoring activity defined in Step A and conducted in Step B produce data in a variety of formats that are stored in Step C. Step D is where these data are then used, along with ancillary data, to address the specific questions defined in the initial planning steps. The inputs of each decision model are defined by the issues' conceptual models and driven by the data collected during the monitoring process on the indicators identified for monitoring. The decision models used are dependant on how well the indicators measured can help inform the workings of the issue model. Because this is an iterative process, products of Step D may or may not be complete enough to understand the issue well enough to properly interpret management outcomes. If this is the case, a return to previous steps in the Standard Process is necessary.

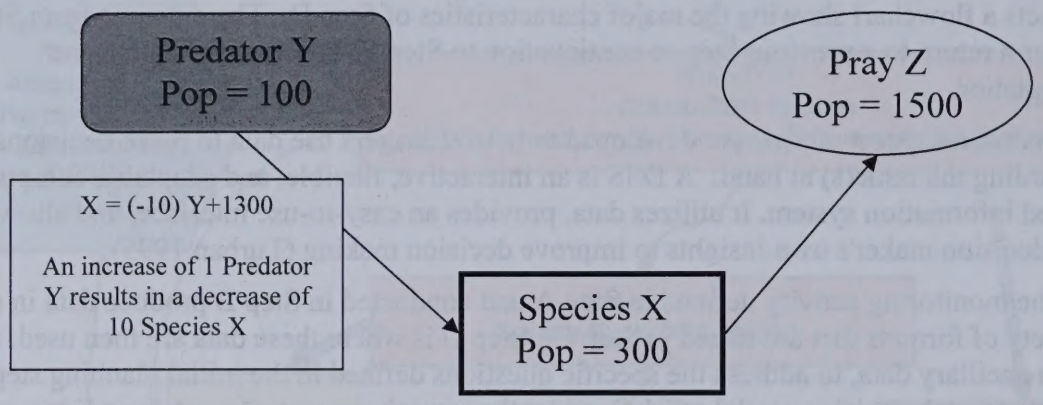
A well developed and thought out DSS will help standardize the decision making process and help identify gaps in the data set. A DSS also provide a legally defensible process that is repeatable and consistent despite different DSS users. The output of the decision model allows managers to assess the status of the issues, decide if the data collected in the monitoring process is complete, and conclude whether or not a satisfactory outcome has been achieved. This process also provides an understanding of how the management activities have impacted a particular resource.

Step D-1: Create DSS Models

In this step decision support models will be created for the priority issues identified in Step A. The DSS structure is dictated by the conceptual models developed in Step A. Specifically, the conceptual model components and the relationships between components will be used to build the DSS. Within the DSS, decision points will be based on RODs and lease stipulations applicable to a given issue and the thresholds determined for the issue in Step A.

A DSS need not be overly complex. The complexity of the DSS will be determined by the complexity of the conceptual model (number of indicators and number of relationships between indicators) and the available data inputs. For example, a basic DSS is shown in Figure 8. In this figure, the conceptual model for Species X Population Size is shown using the model legend developed by the RMT. In this conceptual model, one stressor and one receptor have been identified, and the relationship between the stressor/receptor and the species of interest has been quantified with a simple equation. The population of Predator Y

is the indicator used to monitor Species X, and this is the only data input into the DSS. Using the DSS, we can model the population size of Species X and Pray Z under normal conditions, and we can manipulate numbers to determine when a management action would be required. Figure 8 has two scenarios outlined that result in different management actions.


Predator Y
Pop = 100
Pray Z
Pop = 1500
X = (-10) Y+1300
An increase of 1 Predator Y results in a decrease of 10 Species X
Species X
Pop = 300

Management action required if Species X drops below a population of 125 individuals

Scenario 1: Predator Y population drops by 25% to 75 individuals
Species X = (-10) 75+1300 = 550 individuals
No management action required.

Scenario 2: Predator Y population increases by 20% to 120 individuals
Species X = (-10) 60+1300 = 100 individuals
Management action is required.

Figure 8. Example of a basic DSS based upon a conceptual model with one issue (population of Species X), one driver (population of Predator Y), and one response (population of Pray Z). In this DSS two scenarios are described that result in different management outcomes.

A DSS can also be highly complex. When many model components, relationships between components, and indicators (data inputs) exist, it may be necessary to seek the expertise of a computer programmer. A computer programmer can effortlessly code the equations and data sources into a DSS that allows for more advanced analysis and manipulation.

As a part of this step it is necessary to fully document the DSS, especially in the case of more complex models. The documentation should describe in detail the structure and function of the DSS, and should include the following:

- Issue statement, which includes a review of the issue being addressed and indicators monitored as defined in Step A;
- Monitoring input data requirements, which is derived directly from the conceptual model;

- Decision model characteristics, including detailed model stages;
- Model equations and code; and
- Output information provided by the model.

Step D-2: Review DSS Models

A review of the DSS model should be made by at least one management team member who is familiar with the issue, and a resource specialist. For more complex DSSs it is necessary to have more reviewers. The process should include a review of the model attributes and documentation report. A example Decision Support System Evaluation form is located in Appendix D.

If inadequate, the process is returned to a previous step (Step A, B, C, or D-1). A critique of the model will be generated by the reviewer(s) summarizing the inadequacy of the DSS and recommending revision steps. In the critique, the reviewer(s) will identify if the inadequacy requires:

- A revision of the DSS model;
- A revision of the data management system;
- A revision of the data collection process; or
- A revision of the conceptual model.

If the decision model is found to be adequate, the reviewer should make any reasonable revisions to the model and the model documentation.

Step D-3: Run DSS Models

The structure of each model will dictate any details related to model iterations. In the course of running the decision model it will be apparent if or if not the monitoring program has provided sufficient information for a proper understanding of the issue and issue components. If the model run shows that there is a need for more information, the process should proceed, as described in Step D-2, and a with a critique of the model and recommendation on information needs. If the decision model is successful, the process moves on to Step D-4.

Step D-4: Management Decisions

If the decision model is successful, the model outputs will be useful to the management team in understanding the status of the issue during the time period of the monitoring data set. The decision model will not provide management decisions directly, but will instead provide the information needed for managers to be properly informed so they can adequately understand the management issue. This part of the process satisfies Steps 6 and 7 of the Supplied Framework and Anticipated Approach from the Statement of Work (Appendix A). The decision model outputs and resulting management decisions should be summarized in a set of Interpretive Reports. These Interpretive Reports will contain information for each issue identified in Step A based on the timetable set in Step A.

An Interpretive Report should include the following elements using the output of the DSS:

- A synthesis of monitoring data and research findings.

- A comparison to the expectations defined in Step A for the monitoring program.
- An assessment of the effectiveness of the management strategy and monitoring program.

The Interpretive Reports are the main inputs used in Step E to review the effectiveness of the monitoring program.

E. Program Evaluation and Adaptation

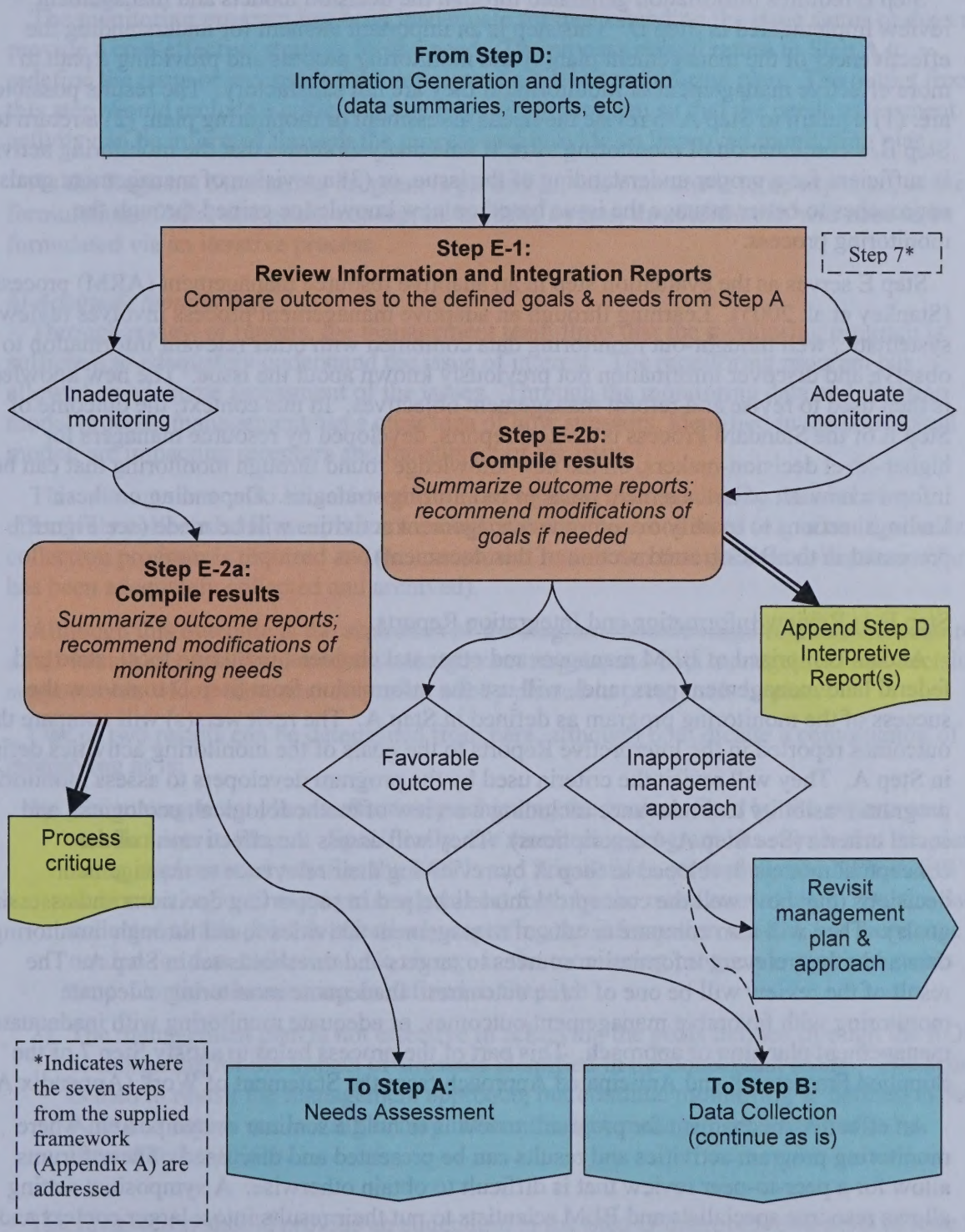

From Step D:
Information Generation and Integration
(data summaries, reports, etc)
Step E-1:
Review Information and Integration Reports
Compare outcomes to the defined goals & needs from Step A
Step 7*
Inadequate monitoring
Adequate monitoring
Step E-2b:
Compile results
Summarize outcome reports; recommend modifications of goals if needed
Step E-2a:
Compile results
Summarize outcome reports; recommend modifications of monitoring needs
Append Step D Interpretive Report(s)
Favorable outcome
Inappropriate management approach
Process critique
Revisit management plan & approach
*Indicates where the seven steps from the supplied framework (Appendix A) are addressed
To Step A:
Needs Assessment
To Step B:
Data Collection
(continue as is)

Figure 9. Flowchart showing the structure of Step E of the Standard Process: Program Evaluation and Adaptation.

Overview of Step E

Step E requires information generated through the decision models and management review implemented in Step D. This step is an important element for understanding the effectiveness of the management plan(s) and monitoring process and providing a path to more effective management or monitoring if they are not satisfactory. The results possible are: (1) a return to Step A to revise the needs assessment or monitoring plan; (2) a return to Step B, a continuation of monitoring as is, if data analysis shows that the monitoring activity is sufficient for a proper understanding of the issue, or (3) a revision of management goals or approaches to better manage the issue based on new knowledge gained through the monitoring process.

Step E serves as the evaluation step in an adaptive resource management (ARM) process (Stankey et al. 2005). Learning through an adaptive management process involves review of systematic, well thought-out monitoring data combined with other relevant information to observe and discover information not previously known about the issue. The new knowledge is then used to revise and reform management objectives. In this context, the outcome of Step E of the Standard Process is a set of reports, developed by resource managers for higher-level decision-makers, on the new knowledge found through monitoring that can help inform a new set of management plans or monitoring strategies. Depending on these findings, actions to modify or continue management activities will be made (see Figure 1 presented in the Background section of this document).

Step E-1: Review Information and Integration Reports

A team comprised of BLM managers and other stakeholders, including local, state and federal land management personnel, will use the information from Step D to review the success of the monitoring program as defined in Step A. The reviewers(s) will compare the outcomes reported in the Interpretive Reports to the goals of the monitoring activities defined in Step A. They will revisit the criteria used by the program developers to assess monitoring program feasibility and relevance including a review of methodological, ecological, and social criteria (See Step A-4 descriptions). They will assess the effectivness of the conceptual models developed in Step A by reviewing their relevance to management decisions (e.g. how well the conceptual models helped in supporting decisions and assessing goals). They will also compare results of management activities found through monitoring data and other relevant information sources to targets and thresholds set in Step A. The result of the review will be one of three outcomes: Inadequate monitoring, adequate monitoring with favorable management outcomes, or adequate monitoring with inadequate management planning or approach. This part of the process helps to satisfy Step 7 of the Supplied Framework and Anticipated Approach from the Statement of Work (Appendix A).

An effective mechanism for program review is to hold a seminar or symposium where monitoring program activities and results can be presented and discussed. These forums allow for a peer-to-peer review that is difficult to obtain otherwise. A symposium setting allows resource specialists and BLM scientists to put their results into a larger context and provides a forum for exposure to new ideas and techniques.

Step E-2: Compile Results

a) Inadequate monitoring

The monitoring program has been inadequate for understanding the issue status or does not provide a cost-effective strategy for the need. The process should return to Step A to redefine the issue or reconstruct the conceptual model or monitoring plan. The output from this step should include a critique of the monitoring program so that the needs assessment activity can be informed through the process and provide an improved monitoring plan.

As the Regional Monitoring Program is phased-in, this outcome is to be expected, as the formulation of adequate goals, conceptual models, targets, thresholds, etc. will need to be formulated via an iterative process.

b) Adequate monitoring

Through review of reports, the management team finds that the monitoring program is sufficient to adequately understand the issue of interest. The monitoring program has allowed an adequate assessment of the issues. Through the monitoring data and decision model process, management has a clear idea of how stressors, identified in the conceptual model, are impacting receptors and the subject of the issue.

This outcome may also be achieved if it is recognized that monitoring data is being effectively collected and used, but not enough data has been collected (e.g. a multi-year data collection program is required and the assessment has shown that the data collection so far has been adequately collected and archived).

Although this outcome is the aspiration of the Regional Monitoring Program, this requires a full vetting of conceptual models, management targets, and data management and decision support tools which can come only after a fully phased-in program is in place.

One of two results can be determined from here, although both dictate a continuation of monitoring as is:

1) The management plan is effectively achieving the goals defined by the experts and stakeholders in Step A. Specifically, the monitoring program has shown that the plan being implemented satisfies the ROP's and Stipulations set forth by the NPR-A EIS's and/or the regional management goals set forth by the management team. Or, the data collected to this point is effectively capturing the information needed, but more time is needed for data collection. No change in the monitoring program is required at this time: Continue monitoring as defined in Step A.

2) The management plan is not effective in achieving the goals defined through the ROD or mitigating for the impact of stressors identified in the conceptual model. The action is then to revisit the management approach, but continue monitoring as defined in Step A so that data is not lacking to help inform the new management strategies to be formulated.

The reviewer(s) should provide an addendum to the Step D Interpretive Reports to state the decision and actions found through the Step E review.

Recommendations for a Successful Regional Wildlife Monitoring Process

Within the main sections of this document we have made specific recommendations regarding implementation of a Regional Monitoring program. Here the suggested implementation is specifically described followed by a review of other specific recommendations made for introducing and implementing an effective Regional Monitoring Process.

Process implementation

Pragmatically, implementing the Standard Process for the NPR-A, Alaska will be done in stages (or phases). The recommended phase-in begins by using existing processes and monitoring data with improvements as noted below, to run through the Standard Process from Step A to E. Some of these steps currently are well developed, while others will need work. *Phase II* will start with a revisit of Step A, and proceed to further development of some of the suggested components of the full process. In *Phase III*, the full process is developed, with processes in place that allow for an effective, adaptive program. Details of the recommended project phases are:

Phase I: Use existing monitoring program with additional capability as follows to go through the Standard Process (Steps A – E).

- Use existing monitoring goals, conceptual models, and indicator list developed by RMT to guide monitoring activities while the full process is developed and integrated in.
- Use and build tools (forms, reports, etc) from existing monitoring activities to conduct monitoring activities.
- Collect & make available important datasets (gaps) that have been identified, esp. regional-scale base datasets & historic monitoring data (data rescue).
    - This would include data conditioning to make it compatible with other data (e.g. GIS-based map products in standardized map projections and formats; historical data scanned/entered into electronic format from paper archives).
    - Data rescue activities should be prioritized to capture the most relevant and useful data for entry into the database management system (e.g. historic data on population may be needed for a thorough assessment of population trends).
- Set up infrastructural components of the process.
    - Develop a data management system for holding and accessing new monitoring data (see Appendix E).
    - Define data management protocols.
    - Create or modify forms, reports, and documentation formats to work with the data management system.

- Review goal-setting process, set up goal-setting stakeholder group, review monitoring program prioritization process
    - The review of the RMT regional monitoring strategy (Appendix F) makes some suggestions. Additional reviews from Step E provide more suggestions for improvement once the process is followed through
    - The goal-setting and review teams set up here would serve in later capacity to review the monitoring program as described in Step E.
- Inspect existing data collection programs for effectiveness and relevance to the stated goals. Implement new data collection procedures, if needed.
- Compile information for current and past monitoring datasets and studies to set initial management targets and thresholds. Scrutinize currently-used targets and/or thresholds, and develop hypotheses to test effectiveness of these targets and/or thresholds.

Phase II: Improve on *Phase I*-level capability and test hypotheses developed under *Phase I* activities

- Revise conceptual models as needed based on review of monitoring outcomes.
    - The Standard Process Step E provides guidelines for this step.
- Improve base data sets (regional maps, climate records, weather data, etc.) based on progress made in *Phase 1*.
- Conduct appropriate validation studies to assess indicator sensitivity and refine target levels and thresholds based on hypotheses developed in *Phase I.*
    - Test the sensitivity of indicators for detecting change in the system and revising indicator choice (Step 5)
    - Test conceptual model validity
    - Test sensitivities (power testing) and targets/thresholds. Set or revise targets and thresholds prescribed by BLM management based on initial data results.
    - Set up hypothesis-driven studies to further vet driver/receptor relationships and other aspects of the conceptual models
- Assess utility of data management systems to help in decision support.
    - Review user provided feedback on functionality and user-friendliness
    - Begin modifications of data management system as needed

Phase III: Fully implemented process

- Finalize modifications to the data management system as determined in early phases.
- Develop mature decision support systems based on experience in the early phases of implementation.
- Develop and implement training in using the process and key process components (data collection and management).

In the first phase, the extensive goals-setting and conceptual-level work done by the RMT for NPR-A will serve as a very solid beginning. The RMT has provided input to satisfy Steps 1-4 of the Supplied Framework and Anticipated Approach from the Statement of Work (Appendix A). This falls in Step A of the Standard Process, and provides guidance for data collection (Step B), data management (Step C), and some initial decision-making by the management team (Step D). So, Phase I is partially complete, and will quickly allow for the NPR-A management team to move on to Phase II. However, as presented in Appendix F, the RMT work falls short in some key areas that need to be recognized and remedied early on in the implementation in order to make sure data collection activities have utility. In particular, the RMT plan does not provide quantified relationships between drivers and responses that are required to fully drive data collection activities or interpret monitoring data results.

In the first two phases, as the full process is being developed, the Standard Process will mature. The final form of the full process may have differences from what is presented here due to the iterative nature of the process. It is through this phased approach, and revisiting of key process components, that a feasible and effective process will emerge.

Review of specific recommendations

The following are recommendations to support the standardized wildlife monitoring process:

1. Develop, build, and deploy a secure and flexible data management system to properly collect, archive, and make available data for regional wildlife monitoring. The structure and characteristics of the recommended system is presented in Appendix E. Step C provides guidelines on how a data management system should be used within the context of a regional monitoring process. The recommended implementation strategy suggests development of the data management system early in the implementation process and integration of data previously collected for monitoring in the NPR-A as a means of making these data accessible to management decision-makers. Data systems currently in use by NOAA-NGDC, USDA-NRCS, DOI-NPS, and USGS, as well as other government agencies, could be used to assess the implementation and support requirements for such a system (see, for example, http://www.itc.nrcs.usda.gov/; http://www.ngdc.noaa.gov/ngdcinfo/aboutngdc.html; http://water.usgs.gov/).
2. Create a secure and common repository (potentially web-based) for information not well-suited for the data management system. Report documents, evaluation forms, meeting notes, etc. are examples of this type of information. This will provide a consolidated and centralized location for all monitoring information and will facilitate collaboration among monitoring participants.
3. Develop and use standardized forms to organize the efforts of many individuals and help guide the progression through the Standard Process. The use of forms also facilitates improved data management (see Appendix D for examples).
4. Use focus groups to address complicated issues such as development and vetting of the conceptual models. Stakeholder participation should also be used to define monitoring goals and sets management-related targets and thresholds.

5. Hold conferences and symposia to communicate and vet monitoring program approaches and results. These forums allow for a peer-to-peer review that is difficult to obtain otherwise. A symposium setting allows resource specialists and BLM scientists to put their results into a larger context and provides a forum for exposure to new ideas and techniques.
6. Provide training to key BLM personnel in:
    a. Data collection (this is already in place by BLM, and should be reviewed and modified if necessary to address the needs as defined by the Wildlife Monitoring Process);
    b. Remote sensing and GIS technologies;
    c. Database use by resource specialist, including data entry, data security, and data visualization;
    d. Database use by decision makers; and
    e. Development and execution of decision support tools.

Expected Outcomes of a Regional Wildlife Monitoring Program

The recommended Standard Process outlined in this document should result in a comprehensive approach to wildlife monitoring as it relates to energy exploration and development on the North Slope of Alaska. The outcomes of a monitoring plan developed using this process will be:

- A complete understanding of how the monitoring activities are achieving the goals of a monitoring plan.
- An assessment of how the management and monitoring programs comply with the requirements laid out in the Northeast NPR-A Record of Decision (ROD) and the Required Operating Procedures (ROPs) and stipulations established through the regulatory process.
- A comprehensive set of monitoring data held in a robust database system that is complete, easily accessible, and available to future generations of wildlife researchers and managers.

A monitoring program that is repeatable, adaptive to change, and considers the bigger picture will focus the process, make it more transparent, and be most effective. Evaluating the effects of oil and gas activities on wildlife resources in regional settings will be: cost effective; improve the collection, integrity and management of data; target research as an aid in management decisions; and incorporate broad-scale assessments, wildlife trend data and other information.

The process described in this document is not meant to be static. As the process is used, problems and inconsistencies will be found, and new ideas on management approaches will be developed. It is expected that this set of guidelines will be modified as it is put into practice in order to have an up-to-date process and the desired outcomes of a wildlife management program.

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Appendices

Appendix A: WREMSS-provided information on suggested process steps

Appendix B: Meetings and interviews conducted during this activity

Appendix C: Northwest and Northeast NPR-A Required Operating Procedures and Lease Stipulations

Appendix D: Sample Forms

Appendix E: Data management system design

Appendix F: Review of the RMT strategy plan